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Harrison

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Chemistry of Paints

WITH PRACTICAL OBSERVATIONS
ON THE USE OF PAINT AND THE
SELECTION OF COLORS.

HARRISON BROS. & CO., Incorporated.
PHILADELPHIA
CHICAGO
NEW YORK

JOHN HARRISON

FOUNDER OF THE HOUSE OF

HARRISON BROS. & CO.,

INCORPORATED

1793

THE

Chemistry of Paints

— OR A —

PARTIAL DESCRIPTION

— OF THE —

Harrison White Lead, Paint, Color, Varnish and Chemical Works,

— WITH A —

PRACTICAL TREATISE ON PAINTING.

PUBLISHED BY
HARRISON BROS. & CO., Incorporated.
PHILADELPHIA

DESIGNED AND MADE BY
HARRISON BROS. & CO.,
INCORPORATED.
PHILADELPHIA
1898

1793 HARRISON BROS & CO 1793

INCORPORATED

THE CHEMISTRY OF PAINTS.

THIS book gives a condensed descriptive outline of our factory, the products made here and the processes by which they are made; the original edition was issued to serve as a guide-book to the members of the Master Painters' Association of the United States in July, 1886, when we had the pleasure of entertaining the entire convention at Grays Ferry. The book is brought up to date, so as to include a mention of the departments, products and processes which have been introduced since the last edition (1890). An idea of the expansion that has taken place may be formed from the fact that in 1886 our plant included 35 different buildings, now there are 60.

The following description of the processes of paint making is largely taken from the guide-book prepared for the above-mentioned occasion, and it is hoped that it will interest and instruct all who may have anything to do with paint.

Pigments and material used in the manufacture of paints are so essentially chemical products that their production is involved in that of manufacturing chemistry; and, as manufacturing chemistry so largely depends on sulphuric acid, it is well to have some information as to the manufacture of this article and its relation, through the many intermediate processes, to the manufacture of paints.

It would be well to note at this point that we were the first manufacturers of sulphuric acid in this country, its production having been begun in 1793, by John Harrison, the founder of the house, who was also the first to employ platinum vessels for its concentration.

Brimstone. With that thought we start at the beginning of chemical processes, showing the pile of brimstone which is the article as received from Sicily, smelted there in a primitive way from the brimstone-bearing rock. This is crude brimstone, and it is procured by a crude process; but by selection a wonderfully pure article can be had.

Sulphur Burners. We next see it burnt in the furnaces arranged for its combustion, known as sulphur burners. Burned in this way the fumes are similar to those given from a sulphur match, and are sulphurous acid gas. This gas, by coming in contact with oxidizing material—generally provided in the form of nitrate of soda—is converted into the higher oxide, or sulphuric acid. The hot gases from the burners are passed through a tower called a "Glover" tower which provides oxidizing material by means of a cascade of mixed sulphuric acid and nitrous products; in this tower the sulphuric acid is mingled with the oxidizing material, and thence carried into the leaden chambers.

Leaden Chambers. We now reach the chamber floor and have a view between two of the leaden chambers, which are known in the factory as "Chambers 3 and 4." The length of each of these is 265 feet. We walk between them to continue our investigation of the process. In these chambers there is a continual commingling of the sulphurous fumes, the nitrous gases and steam; also more or less air, which flows in through the sulphur burners during the combustion of the brimstone. We can hardly say "air," because it is largely nitrogen, or devitalized air—that is, air with its oxygen extracted, the oxygen having gone to the sulphur in the process of combustion. The draught through the chambers carries these mingled gases along, depositing on the way, by a continual dropping, the sulphuric acid, which collects at the bottom. The acid thus collected is known as "chamber" acid.

We now reach the end of the chambers and make our exit from the bullding opposite a tower. This is known as a "Gay-Lussac" tower, from the name of its famous inventor, and is intended to remove any valuable constituents remaining in the gases which have passed through the chambers, and which were not deposited in the liquid acid. In the process of removal a cascade of acid is employed, as in the Glover tower, the object, however, being to take from, instead of to give to, the gases. The acid, flowing continually over proper material, presents a large surface to the ascending gases and absorbs the valuable portions. Finally, the exit is through the high pipe; and when the chambers are working well, the escaping gases are mainly made up of steam and nitrogen.

Gay-Lussac Tower.

In addition to the brimstone acid system above mentioned there are three chambers devoted to acid made from iron pyrites, a natural sulphide of iron, familiarly known as fool's gold; this ore in its purest form is imported and contains about 51 per cent. of sulphur. It is burnt in furnaces differing somewhat in construction from the brimstone furnaces and which are so effective that but 1 per cent. of sulphur remains in the cinders. The gases from pyrites are treated in the same way as gases from brimstone.

We now reach the concentrating apparatus.

The acid from the chambers is first passed into leaden pans supported on iron framework enclosed in brick, in which the first concentration is made. From these it passes into the platinum stills, of which there are two sets constantly at work. These stills are very costly apparatus, although externally they do not impress one as being very valuable. They consist of a number of gold-lined platinum pans enclosed in lead; each pan has an actual money-value of about $4,500.

Concentrating Apparatus.

The Theory of Concentration.

Sulphuric acid is very eager for water—so eager that if a saucerful of oil of vitriol be exposed it will draw the atmospheric moisture to it and soon run over the sides of the dish, increasing its bulk, and weakening itself accordingly. Concentration simply consists of depriving the acid of its water by means of heat. Immense quantities of water are necessary to surround the apparatus to cool the acid after concentration, its temperature being from 600 to 700 degrees Fahrenheit when it leaves the platinum apparatus. In an adjoining building C. P. sulphuric acid is made by the use of the most modern apparatus.

Next we see the apparatus for moving oil of vitriol. It consists of large receivers made of iron lined with lead, into which the acid flows; when filled, the supply is cut off, and air, under heavy pressure is forced on top, driving the acid out from the bottom by a suitable outlet. As acid is almost twice as heavy as water, it will take about twice the pressure to lift it to any height; consequently the air-pressure required is sometimes very great, the acid frequently being lifted to a height of 60 feet. It is forced by this system to the different portions of the works. Its uses in the paint department are numerous.

Sulphuric acid has already been referred to as a sort of prime motor of chemical manufacturing processes; it might almost be compared with the engine that moves the machinery of a factory. It would be difficult to name a paint—or, in fact, anything connected with paints—in which this important material cannot be found as a constituent or directly entering into, or connected with, its preparation. It is a large ingredient, naturally, of that great bugbear of the painting fraternity, "barytes," which is a compound of barium and sulphuric acid. It will be found in all chrome yellows which are paler than a neutral medium, and even in this it is a constituent of some of the salts employed in its manufacture. It will be found in some form in the ma-

jority of the earth paints. It is employed in the refining and bleaching of oil.

In these works is a set of sulphur burners, consuming 9,200 pounds of brimstone daily and also four pyrites burners which require daily a total of 52,000 pounds of pyrites.

The furnaces are operated continually, stopping only for repairs.

The daily product is about 165,000 pounds of chamber acid, equal to 110,000 pounds of concentrated sulphuric acid or oil of vitriol.

As sulphuric acid enters largely into the composition of alum, the manufacture of this will now be described.

Alum Clay Grinding.

We enter the clay-grinding room. This clay is known as bauxite, and the best deposits are found in Georgia and Alabama. It is very rich in the material known as alumina. The clay, after having been thoroughly calcined, is ground very finely in the mills seen, which are kept continually running to grind the large quantity daily used. When this clay is mixed with sulphuric acid, the alumina is extracted, and is finally utilized as alum.

Attacking Department.

Next we enter what is known as an "attacking" department. You will here see the large vats for the treatment of the alum clay with sulphuric acid which extracts the valuable constituent, leaving behind all the insoluble and useless material.

Now we enter another building, used for the separation of the extraneous material from the alumina solution, also for the partial purification of the same. In the cellar of this building we notice engines and mills for the grinding of some of the material used in the purification processes; and on the second floor we find a number of filters, which are used for taking out the remaining light insoluble matter which will not readily settle.

We pass more filters and settling boxes, and see the

alum boiled down to a thick mass which is fluid when hot, but which becomes solid when cold, somewhat resembling clear sugar candy. This is perfectly pure sulphate of alumina, or concentrated alum.

Purest Alum

We continue through this building, passing stacks of alum ready for shipment. Alum bears a highly important part in the manufacture of colors, and it is very necessary that it be pure. The purest made is that known as "Turkey Red" alum and is intended for turkey-red dyers; it must be so pure or free from other substances that one pound of deleterious matter should not be found in 100,000 pounds of the alum.

Alum Used in Colors.

Alum is interesting to the paint man as it forms the basis for carmine and nearly all lake colors, and is used also in greens, yellows, Prussian blues and other paints. The product of these works is about 300 barrels daily. The alum used in the color-making department is the Turkey Red alum.

Special attention is given in this department to the manufacture of filter or water clearing alums. The Harrison filter alums are specially made for the purification of water and are recommended by all the great filter companies.

Laboratories.

We pass out of this building, cross one of the railroad sidings, and go up stairs into the laboratory building where, in one of the best-appointed and largest laboratories connected with any establishment, about a dozen chemists are continually at work examining the crude material that comes into the factory and testing the finished products. Besides the chemists employed in the laboratory, each department is supervised by a chemist who has his own minor laboratory or testing room. In all the processes of this establishment tests must continually be made to determine that the processes are being properly conducted. The "secrets" of our business are the employment of

GRAY'S FERRY OFFICE OF HARRISON BROS. & CO., INCORPORATED.

able talent and a close attention to chemical principles, backed up by a liberal expenditure for experiment.

Directly dependent on sulphuric acid is the manufacture of muriatic and nitric acids, which department is now visited.

Muriatic and Nitric Acids.

Muriatic acid is made by treating common salt, or any other muriate, with sulphuric acid, which takes the place of muriatic acid, the latter being driven off as a gas and collected in the necessary receivers; and for nitric acid the same process is used, nitrate of soda or any other nitrate being employed. Nitrate of soda, being a dangerous substance when near burning material, is always stored in a fire-proof vault.

Chemically pure (or C.P.) acids; sulphuric, muriatic and nitric, as well as C.P. ammonia, are all made in a building contiguous to the group of buildings in which these various acids are made in their commercial forms; these acids find their chief use in chemical laboratories and testing rooms.

Acetic Acid.

Acetic acid is also a dependent of the sulphuric acid chamber, and the department for its manufacture is now properly the next one to examine. The acetic acid employed in the arts is made primarily by the dry distillation of wood. It is a product from the manufacture of charcoal, known in its crude form as "pyroligneous" acid; so that it may be concentrated and carried from the charcoal works, which are principally in the woods, where timber for burning is abundant, it is mixed with lime, and is then known as acetate of lime—a very aromatic substance in its ordinary impure state. By means of sulphuric and muriatic acids the acetic acid is separated from the acetate of lime, and by distillation collected in the necessary receivers. By undergoing various purification processes it is sufficiently purified from the empyreumatic matters

which, because of the source of its production, necessarily accompany it, to be used when properly diluted with water, for household purposes. The acetic acid made in this way is precisely the same as that made from alcohol in the fermentation of cider and other alcoholic material. The quantity of acetic acid made daily in these works is 16,000 pounds, which would be equal to 450 barrels of table vinegar. Acetic acid plays a very important part in color making, forming, when united with litharge, acetate of lead, or the well-known sugar of lead—probably more used in color making than any other salt.

Water of Ammonia.

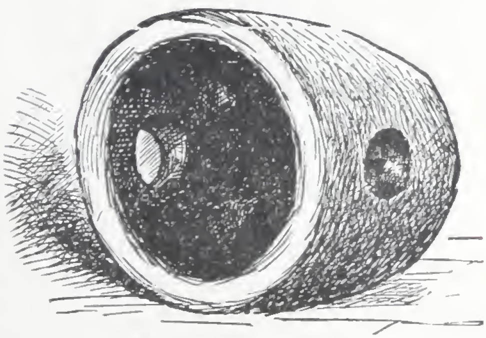
Aqua ammonia is a product of these works, but it is used only to a very limited extent in paint making. The usual process of making it is to heat the sulphate of ammonia with quicklime in a tight cylinder; the quicklime unites with the sulphuric acid and liberates the ammonia in gaseous form. The liberated gas is conducted to receivers charged with water, in which the gas is dissolved. The liquid ammonia, as usually sold, contains eight to ten per cent. of gas. The strongest made contains about twenty-seven per cent. The ammonia gas, by powerful pressure, may be condensed to a liquid which can be preserved only in very strong iron cylinders. This is known as anhydrous ammonia, and because of the danger in its use will never be employed for popular purposes. The original source of ammonia is principally in the manufacture of illuminating gas, there collecting in the gas liquors. The pure water of ammonia is now obtained direct from these liquors without first making the sulphate. Ammonia is very useful to the painter and the householder. It should be in every household in the land. Of course it must be used quickly, as it evaporates rapidly and soon dissipates its strength.

White Lead.

Now we come to the most interesting of all articles to those who have to do with

paints — white lead Its manufacture can be only briefly described. The materials used are pig lead, acetic acid, water and tan bark. By a special machine the pig lead is cast automatically into flat, round perforated plates about five inches in diameter, called buckles. A quantity of these buckles is placed in earth-

"BUCKLE" OF METALLIC LEAD.



EARTHEN CORROSION-POT.

enware pots or jars of about one gallon capacity, each having two large holes in the sides to permit a free circulation of gases. Lugs or shoulders a few inches from the bottom sustain the lead buckles and keep them from touching the diluted acetic acid, which is first poured in. These piles of lead-and-acid-filled pots and tan are called stacks or beds. Everything is made properly tight. The tan soon heats and ferments, and generates carbonic acid; the vinegar in the pots, under the influence of the heat, evaporates and attacks the lead, placing it in a state to combine

Principle of Corrosion.

with the carbonic acid and moisture now in free circulation. In from sixty to ninety days the buckles of metallic lead — excepting, perhaps, a little core — have become snowy-white swollen masses. The acetic acid has disappeared almost entirely. Many of the pots are broken apart by the swelling of the lead. The corroded white buckles are removed first to an apparatus to shake them free from the uncorroded or blue lead, then to the separators, then to mills to grind the whole mass with water into a sort of milk, which is mixed with more water and run through vats and boxes in order to permit all the coarse particles to settle out and to wash out the remaining vinegar. Lastly, the milky liquid is conducted to the final settling vat, where it settles to a stiff paste, which is afterwards dried and then ground in oil. The pig lead, by the aid of the heat and vinegar, has united with carbonic acid and water, increasing in weight nearly twenty-five per cent., and in bulk several times.

New Process Lead

A new process lead, which is gaining quite a reputation with many discriminating painters, is made upon precisely the same principles, but differently applied. The pig lead, instead of being cast in buckles, is reduced to a fine powder; this powder is moistened with the dilute acid or vinegar, then so placed that carbonic-acid gas circulates freely through it, the mass being maintained at proper temperature. Sometimes this is called "quick-process" lead, because it may be made in two or three weeks; but if the difference in the weights of the minute grain of lead powder and the cast buckle be considered, it is relatively a very slow process—much slower than the stack process first described, which is known as the old Dutch method; and it is well established that the more slowly the lead is corroded, the better the body of the white lead.

We have seen all the apparatus for making the white

lead from the pig metal to the dry white powder. Next in order, and immediately adjoining the drying-houses, we enter the department where the dry white lead is ground in oil, but will describe this later on, and will now go into the oxides department.

Oxide of Lead.

Passing a large stack of pig lead received from the cars on the adjoining siding, we enter the furnace-room, where are found a number of retorts. The pig lead is placed in these; and when melted, the retorts are made to revolve, thereby constantly exposing a fresh surface of melted lead to the atmosphere and effecting a rapid oxidation. This oxidation is as much a combustion as in the case of the brimstone. The vital principle of the atmosphere, oxygen, combines with the lead, the first combination, or when the smallest quantity is taken, giving litharge, or the yellow oxide, also known as massicot; a little more gives red lead, or red oxide, also known as minium. If the lead be heated very hot, still more oxygen is taken up, and a brown oxide of no interest to painters is formed; in fact, in the ordinary manufactory such oxide would be called "burnt lead."

Grinding and Levigation of Oxides.

We rapidly pass through this building, by the mills, in which the litharge from the retorts is ground up in water to separate the unoxidized portions, precisely as is done in the corroding department, previously described, by the pans on which the separated fine litharge is dried, and by the mills in which the dry product is ground up ready for packing.

The Retort System.

The retort system—controlled by patents of Harrison Bros. & Co., Incorporated--for making red lead and litharge, as shown here, gives a very pure product; the lead is entirely guarded from contact with the flame, thereby preventing cinders and other dirt from the furnace becoming mixed with it, as in the ordinary apparatus, in which the flame passes over it. A

large part of the product made here is used by flint-glass makers, and, as they can use only the very purest of material, it follows that for all fine purposes in other lines of manufacture where these oxides are required the product of this department should be used.

Oxides for Varnish Makers.

The next in importance to the glass makers is the varnish trade. The "Harrison" oxides are well known among the particular varnish manufacturers, going to all parts of the country, the Western manufacturers especially regarding them as standard goods. The same litharge that is used by glass makers and varnish manufacturers is employed in this factory in color making, and is delivered direct, without any charge for packing or handling to the color-making department, into which we shall shortly enter.

The retorts, twenty in all, require fifty-five tons of lead weekly to keep them in operation.

In a group of buildings of recent construction are made nitrate of lead and nitrite of soda.

Nitrite of soda is a chemical largely used in the dyeing and calico printing trade—of this we are the pioneer and practically only successful makers; the difficulties connected with the manufacture of this article are enormous, and nothing but a large outlay of capital and four years of careful experimenting have enabled us to produce an article requiring the large portion of our factory which has been devoted to it.

Nitrate of lead is used mainly in the manufacture of colors, and this department is largely drawn upon to supply the constantly increasing demand of our color-making plant.

Zinc White.

Next in importance to white lead is zinc white. It is a demonstrated fact that a mixture of white lead and zinc white makes a better paint for exterior work than either singly. While this may seem like heresy to the old-time painter, it is accepted as a fact by unbiased practical men, and by all

scientific writers on the subject of pigments and painting. It is the judicious proportions of these two pigments, together with their thorough combination with, and special treatment of, the oil, that has made the enviable reputation of "Town and Country" paints. We can devote a few lines only to the description of the manufacture of zinc white. The zinc ore is ground to a fine powder and mixed with finely powdered anthracite coal. This mixture is burned, in specially constructed furnaces, on a bed of anthracite previously ignited. The fumes arising are oxide of zinc. They are carefully conducted through proper conduits to houses filled with bags, through which the draft is forced. The gases filter through the canvas, depositing the fine white oxide-of-zinc powder. This is the American method, and with unimportant exceptions all made in the United States is by this method. The European method differs in first smelting the metallic zinc from the ore and subsequently burning it. The different grades of zinc white are established simply by the proximity of the product to the furnace. The bags nearer the furnace will contain the oxide of poorest color and mixed with a minute quantity of ash. The more distant bags will have the whitest and purest oxide.

Method of Manufacture.

Different Grades.

Nothing is more important to the colormaker than the chrome salt, bichromate of potash. *Chrome* literally means "color," and is certainly the great color producer. Chrome ore, a speckled mineral, very hard and heavy, is a combination of oxide of iron and oxide of chromium. It was mined for a long time past in Pennsylvania and Maryland, and recently in California. The supply comes principally from California and the dominions of the Sublime Porte, where probably the richest ores are found. The hard ore is first ground to a fine powder, and until the

Chrome Salts.

Composition and Source of the Ores.

Process of Manufacture.

plan of percussion grinding was adopted it was the terror of millwrights. The powdered ore is mixed with lime and potash (or soda, to make the soda salt) and then roasted at a bright-red heat with free access of air. This causes the oxide of chromium to take up more oxygen and become chromic acid, and to unite with the lime and potash (or soda) present. The mass when cooled is leached and the liquors are concentrated and treated with sulphuric acid—ever present in chemical processes. This acid takes up a portion of the potash and any lime present, leaving the chromic acid united in double the original proportion with the remaining potash; hence the name *bi*-chromate. This bi-chromate liquor is then allowed to cool and crystallize in large vats or tanks, technically known as dishes. In the course of ten days or two weeks the sides and pendent rods are coated with magnificent red crystals, which are drained, dried and packed. The product is of unexampled purity.

Steam Plant

Having studied the manufacture of the more important chemicals required by the color-maker, we are ready to enter the color-making department; but before doing so we will stop at the boiler plant, which is well worthy of description. Originally each department had its separate battery of boilers. In several instances the allotted space had been filled up without supplying the demand for steam. Increase was necessary, and it became apparent that two batteries would be required for one department. After much consideration the plan was adopted of concentrating in one building the steam plant for the entire works. An immense boiler-house was erected, the noble stack, one hundred and seventy-five feet high, seen in the view of the factories given in the fore part of this pamphlet, was built, and large new boilers of the most recent design were placed in the building. This, however, proved utterly inadequate to supply our rapidly growing factory, and accordingly in 1895 we erected a second boiler-house

Yard Scene: Acid Storage Tanks and Tank Cars

equipped with automatic stokers, coal conveyors, fuel economizers and induced draft; this with alterations in the old boiler-house have doubled our capacity; now equal to 4,500 horse power. The pressure carried is one hundred pounds. Railroad sidings are laid on a trestle along the front of the building, permitting the coal to be dumped from the cars directly in front of the boilers, minimizing the firemen's labor. Sixty to eighty tons of hard coal are burned daily, converting into steam from one million to one million two hundred and fifty thousand pounds of water. The steam is supplied to the works from an immense main steam pipe over one thousand feet in length—the largest of the kind in the country at this time. It is all wrought-iron lap-welded pipe, made by the National Tube Works. It begins with a diameter of twenty inches, and is gradually reduced to fifteen inches as branches are taken off. In all its great length there is not one expansion joint. It is laid free on roller chairs, which permit movement over its entire length without strain, to counteract expansion and contraction, which is sometimes seven inches. Not a leak is visible. This is a great triumph in a construction of this kind.

Capacity.

Fuel Supply and Consumption.

Main Steam Pipe.

The cost of this main pipe alone, including its erection and jacketing, was over fifteen thousand dollars. The value of the steam plant is over one hundred and seventy-five thousand dollars.

Cost.

Adjoining the boiler-house is the compressor room, where may be seen three huge air compressors, which keep up a constant supply of compressed air, at a pressure of seventy-five pounds, for use in all the departments requiring it. This has already been mentioned in the description of the acid works, and as we proceed we will notice the air pipes everywhere carrying this useful force which works so silently. Back of the boilers—in a large vault running the

Air Compressors.

length of the boiler-house, one hundred and fifty feet—may be seen various pumps, storage tanks, etc., used for collecting and storing all the condensed steam, which is pulled back to the boiler house, to be used again in the boilers—a perfect circulation.

1,500,000 Gallons Water Supply and Fire Pump.

Near by are the powerful pumps, running night and day to furnish the great quantities of water required. A ten-inch main is scarcely sufficient to supply the works. In the same building, which is absolutely fire-proof, is a large fire pump, which is arranged to work automatically even when flames so surround it as to render it unapproachable.

Machine Shop.

The steam plant is under the charge of an experienced engineer. Connected with it is a large machine shop, where all repairs are made and much new work is constructed. All the mills used in the paint department are of special construction, and built in the machine shop. This shop is a special feature, and its importance may be determined from the fact that, at times, fifty machinists and iron workers are employed.

Color-Making Department.

Having examined the various departments where are manufactured the more important chemicals used in color-making, we may enter the color-making department itself. The capacity of this department was at the beginning made unnecessarily large, in order to provide for a large increase in output; this estimate, however, was a little too conservative, as it was found necessary during the past year to practically double the capacity by extending the plant, supplying new tubs, filter presses, monte-jus, drying rooms, etc. This department is really a group of factories which would of themselves form an independent business, and there are many prominent firms and corporations whose plant consists only of what in the Harrison works is a single department.

American Vermilion.

The first minor department we enter is for the manufacture of American vermilion; this article is a combination of chromic acid and oxide of lead, the latter existing in large proportions. It is made by boiling together white lead and bichromate of potash, and subsequently treating the product with sulphuric acid; the result is a crystalline orange chromate of lead. The Harrison brand is known as "Chinese Imperial Scarlet." Its use was at one time almost universal in agricultural implement and wagon factories, but recently the imitation of English vermilion has greatly surpassed it. Considering its cost and durability of color, it is, after all, a very useful pigment, and is yet the standard color of many such establishments. If the crystals be crushed, the color thereby becomes much lighter, or the same as the uncyrstallized orange chrome. American vermilion is very frequently adulterated with red lead and barytes.

Quicksilver Vermilion.

English vermilion is a combination of sulphur and mercury. Mercury or quicksilver, sulphur and a solution of soda are placed in a heavy iron cylinder so constructed that when it is rapidly revolved a violent agitation of the contents results; great heat is generated, and the sulphur and mercury unite. Extreme care is necessary to secure a good color. A natural color of the combination of sulphur and mercury is black, and the red color is largely due to friction. The chemical composition of both the black and the red sulphide is precisely the same; the difference is due to a difference in the arrangement of the particles, or what the chemists call the molecules; a chemist would say it is a difference in molecular structure. This fact accounts for the tendency of quicksilver vermilion to blacken: it is the tendency of the compound to return to its *more natural* black state. As there is always an escape of sulphuretted gases in the manufacture of this article, it is necessary to conduct it in an isolated build-

ing freely ventilated; otherwise, all the lead colors—such as yellow chrome, green, etc.—would be seriously damaged by the formation of the black sulphide of lead.

Harrisons' Unfading Vermilion.

In the building where American vermilion is made is also produced a vermilion which bids fair to revolutionize the vermilion trade, just as eosine vermilions did when they superseded quicksilver vermilions for practically all commercial uses; this color is Harrisons' Unfading Vermilion, a beautiful rich vermilion that neither darkens nor fades as do all the vermilions known to the painting fraternity.

Harrisons' Unfading Vermilion has been adopted by the U. S. Postal authorities for use on the letter-boxes in over fifty cities: it has been extensively adopted by agricultural implement makers, and by painters for railroad signals, wagon and store-front painting.

We all know that one of the most wonderful exploits of chemistry was the discovery in nasty coal tar of the most brilliant dyes. One of these dyes is called eosine. By itself it is an exquisite rose color; when the red oxide of lead is dyed with it a magnificent vermilion is obtained, as much brighter than the quicksilver vermilion as the latter is brighter than the lead vermilion. This brilliant pigment is known as imitation vermilion, and is sold under various fancy names, many of the manufacturers adopting the names of the celebrated mines of quicksilver. One of the most famous mines is that of Idria, in Austria; the imitation vermilion made at this factory is named after that mine, prefixing the word

New Idria Vermilion.

"New." New Idria vermilion is well known to all consumers of vermilion as one of the best of the class. New Idria vermilion is made from the finest orange mineral dyed with the strongest eosine. As are all other colors, imitation vermilion is grossly adulterated, and, as usual, the chief adulterant is barytes; some specimens contain as much as eighty-five per cent. Other adulterants are

whiting and terra alba. Some are made with the addition of white lead; this requires more eosine and a beautiful crimson shade is produced. This, however, rapidly fades on exposure, and the best and most permanent is that made with orange mineral and eosine only, which give the rich scarlet shade.

Drying Rooms.

The operations of making the American and imitation vermilions are conducted in large vats or tubs. The finished color is then freed of its water as much as possible by filtering and pressing, and the moist mass is afterwards removed to the drying rooms, where the remaining moisture is dried out. In the past the final drying required weeks; now days are sufficient. The unscientifically constructed drying closets are replaced by rooms built entirely of brick and iron. Each room is provided with a fan, which forces throughout the entire space a continuous current of warm dry air in a complete circulation. The color, in cakes, is placed on trays which are laid on racks. Each color has its own room. The fans are run by small engines, which operate day and night until the cakes of color are bone dry. The room is emptied and filled again, closed up, and the operation continues with the least possible loss of time. Each sub-department of the general department of color-making has its own drying rooms. From the drying rooms the vermilions are taken to the grinding and sifting apparatus and reduced to the fine state in which they are found in the dealers' hands.

Chrome Yellow.

The next department we visit is that for making yellow and chrome. These also are combinations of chromic acid and oxide of lead; but for these lead salts—the nitrate and acetate of lead—are used. A nitrate of lead will give a yellow with physical properties different from one made of acetate, though both have precisely the same chemical composition. This is again due to the different arrangement of the molecules. We see large vats in which the vari-

ous salts are dissolved; when of the right temperature and density, these solutions are run together in large vats, and the color is seen to develop. This is called "striking" the color, and the operation is one of great delicacy. The chemical change is easily understood. Acetic acid and oxide of lead are combined as sugar of lead; this is soluble in water. Chromic acid and potash are combined as bichromate of potash—a salt also soluble in water. When the two solutions come together, the chromic acid goes to the lead, making chromate of lead, and the acetic acid goes to the potash, making acetate of potash. The chromate of lead is the insoluble chrome yellow, and settles out of the solution. The acetate of potash is soluble, remains in the liquid with the color, and is finally washed out with pure water. This operation is one of precipitation. The reaction is called double decomposition, and the foregoing explanation answers for all colors made by precipitation.

Theory of Precipitation.

The nitrate of lead as well as all the acids, and nearly all the chemicals which we use in the manufacture of colors, are made with scrupulous care in our own plant; nitrate of lead is used in making yellows, greens and vermilions.

Color-Making a Science.

This leads us to consider color-making in a more general way. We are now in the chief color-maker's office, and find it quite similar in appearance to the laboratories referred to on page 8. It is a laboratory as well as an office. The chief color-maker is a chemist who received most of his training in the general laboratories of the works; his assistants are required to be able to make chemical tests, and are expected to familiarize themselves with the chemical knowledge bearing directly on their work. While color-making involves what might be called many "rule-of-thumb" operations, yet every one of these so-called "rule-of-thumb" practices, when viewed from

a scientific standpoint, is capable of being resolved and amplified into *scientific* practice. Much mystery is thrown around this business, but, after all, success depends upon education guided by practical experience. Many of the most valuable chemical theories have been evolved from facts or results noticed and known for a a long time by workmen, and it is only when some one of them inquires into the cause of certain effects that the reason or theory is finally discovered and more fully and scientifically applied. When, in the color-making department, it is ascertained that brown sugar of lead—an impure salt as compared with the beautiful white crystallized sugar of lead—will make certain colors which the white will not produce, we soon learn that the very impurities, which consist of pyroligneous matters, have a peculiar mordanting effect which prevents the reaction of the residual salts on the newly-formed color—a reaction that would take place if absolutely pure chemicals were used, without the pyroligneous mordant or its equivalent.

Adulteration of Color.

Barytes is the common adulterant of all paints, and is used immediately before or after "striking" the color, according to circumstances. Probably no other industries offer the same opportunities for downright robbery, by means of sophistication, as paint-making and painting. The unscrupulous paint-maker uses increased doses of barytes as competition lowers his prices. The dishonest painter makes two coats of paint fill his contract for three; he buys adulterated oils, or wilfully adulterates them; he will take a strong-bodied and originally reliable paint, and by reducing it with all the cheap and vile material it will bear will make a profit out of a contract taken at a rate that would net only a loss to the honest man.

Fortunately the great majority of painters are honest; and the crusade against low-grade paints started by the proprietors of the works we are now describing is forcing

unscrupulous paint makers to adopt higher standards. While barytes is used almost invariably as a mere adulterant, it occasionally serves the purpose of diluting a color, or, more properly speaking, of separating its particles and delaying—or preventing, possibly—chemical reactions which speedily might occur were the color perfectly pure. In its precipitated form, or as blanc fixe, it is an invaluable material when used as a base for certain light lake colors which could hardly be collected but for such a base; so, when the analysis of a color shows the presence of barytes, it is necessary to go farther—and the intelligent analyst knows how to go farther—to discover whether this sulphate of baryta which he finds is the crude native mineral simply ground to fine powder, or that precipitated to impalpable fineness from solutions —the blanc fixe. The proprietors of these works stand alone in having for a long time past steadily and persistently exposed to painters the frauds practiced upon them; yet they know that sulphate of baryta is like a great many other things in constant use; it may be used properly or it may be abused. On general principles, however, it is safe to turn resolutely from any color which consists largely of barytes. Some colors are wonderfully strong, and may *apparently* still be good colors, when there is no standard near for comparison, and yet may contain ninety-five per cent. or more of this adulterant.

The Mechanics of Color-Making.

To insure success in these days of intense competition, not only must the scientific features of color-making be well understood, but all the mechanics of the business must be thoroughly studied. In these works every known appliance is used; the agency of compressed air is brought into play wherever possible; the old-style slow-working filter and the hand press are replaced by the filter press,

Filter Press.

in which machine are combined the two operations of filtering and pressing. Some colors, such as vermilion, will not readily permit the

Scene on One of the Eleven Streets Which Traverse the Works

employment of the filter press, and for such colors very few modifications of the old processes are practicable. Colors such as chrome yellows, chrome greens, Prussian blues, Tuscan red and the lakes make a thin fluid pulp which may be forced into the filter press through pipes. The thin color is run from the striking tub, after it has been washed, into a vat of sufficient size to hold several batches; in this they are intimately blended, to insure uniformity of shade. Next they are run into a cylindrical vessel made of very heavy sheet copper; this is called a *monte-jus* (meaning to raise liquid); and when filled, the inlet is closed. A pressure of fifty to eighty pounds to the square inch is applied to the surface of the pulp, which forces it from the exit tube opening at the bottom of the vessel and connecting with the press; the press is rapidly filled up, and the cakes of color become very dense, the water being squeezed out by the powerful pressure.

Use of Compressed Air

The air pressure is used in the color-making department to move acids and chemical solutions which would corrode pumping machinery; the operation is swift, noiseless and certain. The compressed air is also made to do other work that formerly was done by the hand of the laborer.

Chrome Greens.

The description of the manufacture of chrome yellow applies also to that of chrome green. This is really a mixture of yellow and blue, and the two colors are thrown down together, which gives a brightness and a permanency not obtained by simple mixture. When the yellow is taken from the drying-room, it is ready for sale as dry yellow, or for delivery to the grinding department to be converted into oil color. Chrome green, before it is packed for sale dry or before it is transferred to the color grinders, is first reduced in dry color mills to a fine powder.

Sylvan Green.

Sylvan green, so well known to the trade in general, is made here. This is a very perma-

nent and brilliant green, and it is made in six shades—from very pale to very deep.

Chinese Blue and Prussian Blue.

Chinese and Prussian blues are produced from prussiate of potash and an iron salt—usually copperas. If the yellow prussiate of potash and copperas be used, the color, when first struck, is *white;* this by oxidation turns blue, and the oxygen of the atmosphere will effect this change if sufficient time be given. To obtain quickly the rich deep blues with a lustre of bronze, there must be recourse to powerful oxidizing agents, aided by heat. Strong nitric acid is used for some blues, chlorate of potash for others, and various other agents are employed. Soluble Chinese blue for the laundry is an important feature of the blue department. There is but very little chemical difference between the ordinary Chinese blue (which is insoluble in water) and that which is soluble; this quality of solubility is obtained chiefly by special manipulation. Blue is very light, and it forms a very bulky paste; hence for the same product more presses are required in this department than any other, excepting in that for the lakes. The advantage of the application of mechanical principles in increasing the output is not so well shown anywhere else as in this department. Were the old methods of filtering, pressing and drying now in use, at least five times the floor area would be required for the present output.

Leaving the sub-department for blues, we enter the factory for the manufacture of Tuscan red and of lake colors. The apparatus in this department is quite similar to that we have seen in the others—the striking tubs, though somewhat different in shape, the filter presses, with the addition of peculiarly-shaped copper vessels, resembling a ball drawn out; these are suspended in iron frames which permit them to be turned over in order to discharge their contents. These are known as autoclaves or digesters, and their purpose is

to extract the coloring matter from dyewoods; the extracted coloring matter, in liquid state, is stored away in vats until wanted for use, when it is precipitated, by means of alum, tin salts, barium salts, etc., according to the nature of the lake and the color or shade desired. The texture of some of the very fine colors made in this department would be injured by the severe pressure of the filter press, and for these, vacuum filters are employed, using an opposite principle, apparently, but really the same; for by means of a partial vacuum the natural pressure of the atmosphere is in part realized. The principal dyewood used is Brazil-wood, from which is produced the lake most largely used in paint-making, chatemuc. This wood also gives us rose pink, which is simply a lake precipitated on Paris white. Carmine and its lakes are obtained from cochineal. The carmine apparatus is entirely distinct, and is separated from all the others. The majority of the lake colors are comparatively fugitive; therefore it is desirable to select such material as will give the more permanent colors.

Colors from Dyewoods.

Tuscan red is made in this department; generally it is simply a mixture of Indian red and rose pink. Harrisons' New Tuscan Red is made upon scientific principles and is the most brilliant and most durable color of the kind that is known. The enriching lake is almost imperishable, and will bear a temperature of 400° F. without being sensibly affected. Tuscan red is a sort of connecting-link between the lake colors and the mineral colors. The "Town and Country" Ready Mixed Paint No. 618, which is such a great favorite, is made from this new Tuscan red.

Tuscan Red.

Many of the recently-produced coal-tar dyes have much greater permanency than those first made. This enables the paint-maker to give to his trade brilliant pigments that theretofore were unknown. One produced here is the now celebrated car-

Coal-Tar Pigments.

mine substitute—a color much less costly and of more body than carmine, but equal to it in brilliancy and permanency.

Powdering Machinery.

The machinery for powdering dry colors is a very important feature of this large color-making establishment, and is quite distinctly separated from the apparatus employed in the other processes. Mills are the same in principle, as a rule, no matter what their special use, and the description of one answers for all; special mention of them will be made farther on. It will be noticed that great care is taken to isolate each color completely. In one room, in which everything is green, there are several mills, and breakers and great piles of green on the floor. To keep the shades of standard goods strictly uniform, 25,000 to 35,000 pounds of the dried color are manipulated at one time. The dried color is brought from the drying-rooms directly here; it is immediately passed through the breakers and then piled in heaps and mixed thoroughly; afterward it is fed to the mills, ground to the required degree of fineness, and discharged through spouts into the storage-bins on the floor beneath.

In the blue-grinding department are two divisions, one is for soluble or laundry blue only, and the other for Chinese and other blues intended strictly for pigment use. In one room the prevailing color is maroon, and here Harrisons' New Tuscan Red is ground to an impalpable powder. In the red-milling department there are three divisions—one for quicksilver vermilion, one for American vermilion and the other for New Idria vermilion. As the vermilions are more deleterious to health than other colors, precaution is taken to keep the air clear of dust. Over the hoppers of the mills, and over all points where dust may escape, inverted funnels connected with large galvanized iron pipes may be seen; these all run into one large pipe, in which there is a powerful fan drawing

Precautions for the Health of the Operative.

the air through these funnel-openings, and with it all the dust. This dust-laden air is forced into a properly-constructed dust chamber, where the greater part of the floating color is deposited; that which is not caught in the chamber is collected by means of a spray of water. Similar appliances were seen in the oxide and white lead departments, and are in use where all dangerous dusts arise. Workmen in these departments are required to change their clothing in a special room entirely apart from the work places; adjoining these dressing-rooms are large bath and wash rooms, where every facility is afforded for a thorough cleansing of the body after quitting work.

Leaving the group of factories constituting the color-making department, we pass a detached building in which are several huge vertical iron cylinders with some peculiar attachments suggesting steam-boilers. These are the water purifiers. The water used in color-making must be very pure—not merely clear, but free from all soluble impurities, particularly organic matter. These purifiers remove not only the visible, but the invisible, impurities; they give purer water than can be obtained from any settling pond or crystal lake, and are of material aid in securing the brilliancy and richness of the "Harrison" colors.

Water Purifiers.

In the regular course of affairs the operations following the color-making are those for grinding the colors in oil; but before entering the oil-color mill-house we should inspect the dry color-grinding department, where all the earth colors are specially treated to develop their best qualities. In one of the adjoining storehouses may be seen great tiers of barrels, casks, and hogsheads, the contents of which are suggested by their exterior coloring. Here is a lot of casks holding something very yellow, each package having a peculiar brand burnt into the head; it is an invoice of the celebrated Auxerre ochre. The marks "ss Illinois

Dry-Color Storehouse.

8-29-97" indicate that it was received by the steamship Illinois on August 20, 1897. Adjoining is a pile of frail and awkward-looking packages which contain Italian sienna; the marks "bk Mio Padre 11-8-96" indicate that it was received by the bark Mio Padre on November 8, 1896. In this manner each importation is kept distinct. There are numbers of stacks of the same kind of packages some with a reddish look, others with a yellow or brownish stain; they all contain siennas. Some of them are in a raw state, some of them burned. Those ugly hogsheads, each large enough to hold a ton or more, contain umber. This one storehouse is 60 x 150 feet, with a convenient drive-way through it; it is filled with these foreign goods; ochres from France; siennas from Italy; umbers from Cyprus and Italy; browns from Germany—a big shipload in all. That immense stock explains the enigma to those color-grinders who are puzzled about the uniformity of the Harrison siennas, umbers, etc. These earth pigments in the original state vary so much that no two invoices are alike; only by having a varied stock which may be mixed in proper proportions can a uniform color be maintained.

Dry Color Grinding Earth Paints etc.

In the dry-color grinding department the crude earth paints are carefully picked and sorted and dried; they are then mixed in the proportions that will give the standard shades, and finally ground to an impalpable powder. Even those colors, such as ochres, metallic browns, colcothars, etc., which by all other paint-makers are considered sufficiently fine to grind in oil at once, in this establishment first are treated in this department; none of these goods (and only the finest are admitted here) are fine enough.

The careful observer will notice in his journey through these great works the complete independence of one department from another. Thus in the dry-color grinding department is an independent engine, enabling work to

be done continually, day and night, if the demands of the other departments, which may be run only in day-time, makes this necessary. No color can be properly ground unless it be bone dry; and for drying purposes may be seen large steam-heated, open drying pans and steam-jacketed revolving drums of different sizes; also apparatus which both dries and mixes at one operation. Drying is an important operation for the tone of some of the colors is much impaired by overheating. The mills are of special construction, and are almost noiseless in operation. Their work is at variance somewhat with those mills of which it is said:

> "Though the mills of the gods grind slowly,
> Yet they grind exceeding fine,"

for these not only "grind exceeding fine," but grind very quickly and in large quantity. The impalpable color is discharged into tight cars, which are really movable bins, all of one size, holding 500 to 1,000 pounds each, according to the nature of the material. These cars are used to store the color until it is required in the oil-color mill-house.

Nature of the Earth's Colors.

While the colors which are more directly the product of chemistry in so large measure owe their existence to chromium, the colors of this department—Nature's products, as it were—owe their being to iron almost without exception. The rich brown umbers, the bright siennas, the beautiful maroon in all various shades of Indian red, Venetian red and ochre,—all of them owe their coloring to iron only. Vandyke brown owes its color principally to carbon. Ivory black owes its color entirely to carbon.

Oil-Color Mill-House.

The grinding of colors in oil naturally follows the dry grinding; and we now go into a building erected especially for the purpose upon most carefully devised plans, and provided with all the latest and best appliances.

While the mechanical methods and processes now employed in many of the important industries which have risen to their present prominence within a comparatively recent period resemble but little the early and hand processes which they have supplanted, the reverse of this is the case in the grinding of colors: the mills are made much more accurately, more highly finished and of material better adapted to the purpose than they were some years ago, but there are no essential changes, and, after all, it is only an evolution from the slab and muller, and no real change in process. The mixer, however, that is now employed can hardly be connected with the idea of mixing dry-color and oil in a keg laboriously by hand. Even the mixer of comparatively recent production, with its one set of fixed and one set of revolving arms, cannot compare with the one which is here used, and in which, by means of complex motion, the thorough incorporation of the pigment and oil is rapidly effected, and with economical expenditure of power.

Grinding of Colors.

Modern Ideas.

In this great mill-house the progress of modern ideas is especially shown in all the arrangements whereby the costly but needful labor and power are minimized.

Light and Ventilation.

The exterior of the building is necessarily plain; it is so constructed as to cause the complete lighting of the interior by numerous large windows, the flood of light reaching the very centre of every floor. Due consideration is also given to ventilation without draught, so that there is as little dust as possible.

Starting at the third floor, we see here dry colors in the dust-tight, wheeled bins which have been brought over from the dry-color grinding department. There are also such stationary bins as may be necessary and convenient.

The dry material is first passed to the dry-machines,

A View in Grinding Room of Color Grinding Department

so that all absorbed moisture may be driven out and the color properly warmed for mixing. It is then transferred to accurate scales, carefully weighed, and quietly but quickly placed in the mixers, with the oil or other vehicle added in carefully weighed quantities; all of this work is attended to by a clerk in charge.

Preparing the Dry Material for the Mixer.

This preparation and mixing of the colors for the mills is the principal operation on this floor. Every appliance in the way of trucks, turn-tables, etc., for the rapid movement of material may be seen; also the necessary oil, varnish and japan tanks with their gauges and scales.

Appliances for Mixing.

On the second floor we see nothing but mills—big mills and little mills, all shapes and sizes—designed especially for the work required of them, one pigment working better in one kind of a mill than in another; and here let it be said that the color is not ground once or twice or any specified number of times; the great secret of the success of this establishment is, that the color must be ground until it has reached the required degree of fineness, whether the number of times it is passed through the mill be one or twenty.

Mills.

Fineness of Grinding.

A feature that will impress the careful observer is the entire absence of iron mills—that is, mills with metallic grinding surfaces. It was long ago decided here that these were unfit for grinding colors when purity of tone was essential. In a compartment entirely separate may be seen the mills for grinding the coach colors. The fresco and distemper colors which are ground in water, and the tube colors for artists' and decorators' uses, and lithographing inks, are also prepared here.

Coach Color.
Fresco Color.
Artists' Color.

When the paint has been finally passed by the inspector, it is conveyed by elevators to the floor directly below, employed for packing,

Storing and Packing.

storage and shipping. Much of the finished paint is packed at once into cans or other packages. That which is not packed immediately is deposited in carefully protected storage-tanks. The packing, sealing and labeling of all small cans are done by neat-handed girls, and many devices are utilized to secure speed, economize space and minimize labor.

Loading Facilities.

This packing floor is at such elevation as to be level with the floors of cars or wagons; railway tracks pass by the two ends of the building, and along one entire side teams may load.

Winter Stock.

Below this floor is a good high basement, in which is stored all of the output that is packed for stock; here the production of the winter is accumulated, ready for the demands of the spring trade.

On the first floor at one time may be seen large orders in preparation for the branch houses in New York and Chicago, and for large dealers in the principal cities.

Description of Mill-House.

This mill-house is 75 x 150 feet in area, and it is devoted solely to the preparation of colors. The height from floor to ceiling is quite unusual, insuring good distribution of light. The construction is on the modern slow-burning plan, which also insures freedom from dust. The elevators are run at high speed, so that the movement of material and product is made with quietness, accuracy and dispatch. It is noticed that there is no retrograde movement in the handling of the material, and this is a very important matter in the saving of labor. The great engine which furnishes power for the mixers, mills elevators, etc., occupies an annex devoted to its exclusive use.

White Paints.

We will now enter a much older, though equally substantial, building of the same size as the one just left; this is used principally for the preparation of white paints. The white lead

manufacturing departments have already been visited on pages 11 and 12.

From the drying pans or kilns the finished product is taken by cars over an elevated track directly to the third floor of the building we are now visiting. On this floor the white lead receives a certain quantity of oil, and is chased and mulled so as to induce the saponification that gives to white lead its superior body; this treatment leaves it like putty. The mass is then chuted to the mixers on the second floor, where a further quantity of oil is incorporated and the proper consistency for grinding obtained. The mills are on the first floor, and are fed directly from the mixers; two systems of grinding are used—the new roller mill and the old or flat circular stone mill.

Treatment of White Lead

White lead in oil, like wine, grows better with age if so stored as to prevent oxidation of the oil; in order to give our trade the advantage of this we recently erected a mammoth storage building, fitted with circular storage tanks of 40 tons capacity each, from which the lead is run by gravity directly into the packages.

All the white lead from this factory has a beautiful silky texture, and is not excelled by any made in the qualities of extreme whiteness, opacity, fineness and spreading power; in fact, any that equals it is an accidental rather than a regular product. More attention is here given to supplying the particular requirements of different consumers than in any other establishment; many corroders will grind their lead in but one way; the boast of this place is that all proper requirements are provided for.

Features of the Harrison White Lead

A very stiff lead, almost like cheese in consistency, is known as "A" lead, and is especially acceptable to those who have been accustomed to old English lead.

The "I S" is a stiff lead, softer than the "A," but

particularly adapted for fine inside flat work, where absolute freedom from gloss is a requisite.

A still thinner or oily lead, intended for general outside work, is known as "O" lead.

The "Carriage Makers' Extra White Lead" is specially selected from the very densest, heaviest-bodied stock of the finest texture.

The special requirements of those manufacturers who use white lead in large quantities have been carefully studied and provided for.

Lead and Zinc Paints.

In addition to the grinding of pure white lead and zinc paints, a mixture of zinc and white lead, intended for the "Town and Country" paints, is prepared in this building.

The paint for the ready-mixed department is carried to it in iron cars, so arranged as to discharge directly into the ready-mixed paint mixers.

Oil-Treatment House.

Before entering the ready-mixed paint department a general inspection of the processes of receiving, storing and distributing the oil, and a trip to the oil-treatment house should be made. The oil is received in barrels or tanks in car-load lots; if in barrels, the entire load is run on a long skid over a trough, bungs are drawn and the sixty barrels are drained at one time into the trough, which, by the necessary pipes, discharges into the receiving or storage tanks; these tanks are made of boiler iron and placed at such points as may be convenient. When the oil is delivered by car-tanks, it is discharged directly into the receivers by gravity. The storage tanks are all connected with a general pipe system, by means of which, and the aid of the ubiquitous air-pressure, the oil is distributed to any desired point. The pipe system is extended under one of the main streets to the oil-treatment house, situated in an isolated position beyond the boiler-house, and nearly one thousand feet from the point where the oil is received. The oil-treating house

is necessarily of fire-proof construction; in it all the oil used in "Town and Country" paint is clarified and made more elastic and durable by boiling and other processes. For simply boiling the oil there are five hooded kettles, in which 1,700 gallons may be treated at once.

Stone-Dressing.

The stone-dressers should not pass unnoticed. In a room by themselves may be seen the half dozen men who are constantly at work keeping the mill-stones sharpened. The proper operation of grinding is not dissimilar to cutting with shears. The edges must be kept sharp, for when a mill-stone loses its "dress"—that is, becomes smooth and glazed—it will not cut the particles of material into smaller particles; it may mull or crush, but it will not grind. An interesting tool for doing this work is the pneumatic stone-dresser, which materially hastens the operation. All of the stone-dressing for the entire plant is done here, the mills being so arranged that both the bed-stone and grinder may be removed.

Minor Features of the Plant.

As the manufacture of the "Town and Country" ready-mixed paint is the culminating work of this establishment, we will mention some other departments before describing the one devoted to its manufacture.

Stable.

On our way from the oil-treatment house we take a glance at the stable; airy, well-lighted, well-ventilated and equipped, as it should be, for the forty-five magnificent animals it houses. The draught horses are mostly Clydesdales, weighing 1,600 to 1,900 pounds each, and when doing their work (without apparent effort) in front of the large and heavily-loaded wagons, they well represent the substantial character of the business.

Printing Department.

The printing office is a necessary adjunct; in it every label, price list, circular, etc., that pertains to the business, is prepared; all of the work of this pamphlet was done in it. It has estab-

lished an excellent reputation for choice color work; the inks used are prepared in the color mill-house, on special water-cooled mills.

Our new electric light and power plant is, for the most economical distribution of power, situated in the centre of the grounds. This plant supplies power to the various motors, placed where circumstances prevent the use of steam, to the 19 arc lights by which the streets of the factory are lighted, and to the 1,100 incandescent lights distributed through those buildings which require light; the dynamo room is thoroughly modern and is one of the most attractive points in the factory. Our electric light system represents an outlay of $15,000. A good idea of its capacity may be had when it is known that 1,124 towns in the United States are lighted by plants of smaller size.

Constant supervision of our chemical and mechanical work is absolutely necessary, as a breakdown in one requires instant attention from both the chief chemist and the chief engineer; in order to make this possible we recently erected upon ground adjacent to the factory two modern dwellings thoroughly equipped with every housekeeping convenience; these are occupied by the heads of departments above-mentioned.

Transportation Facilities.

Another feature that impresses the visitor is the system of railroad tracks ramifying the entire plant and connecting with all the trunk lines entering the city; there is over a mile and one-half of railroad tracks in the works, and these give three direct connections with the main tracks of the railway lines passing in proximity. Lying directly on the Schuylkill River, vessels discharge brimstone and other crude material from foreign sources without cost of lighterage or other handling; in fact, every facility is afforded for receiving material from and shipping it to all points, and for the conduct of the business of the establishment upon the most favorable conditions.

Ready-Mixed Paint Department.

Entering the "Town and Country" Ready-Mixed Paint department the visitor is impressed by an array of tanks carrying their height through two floors. These are the mixers, eighteen in all; they are double—that is, one tank within another—and with internal machinery that beats and mixes the material into a homogeneous consistency. The pigments and vehicles are charged into the tanks from the fourth floor of the building. The paste white lead and zinc white are brought up in iron cars; the liquids are delivered by the air-pressure, and when material equal in volume to 700 gallons is placed in each mixer, the powerful machinery is set in motion, and the process of churning, beating, dashing and mixing is continued for two days. Can any hand method in any way approach this in effectiveness? These mixers are only for making the white base of the paint; the coloring is done in smaller mixers. The powerful tinting colors are first reduced with oil in mixers, somewhat similar to the large ones described, to a very thin consistency, and then added to the white base in the coloring mixers in the right proportions to produce the desired tints; these coloring mixers make 150 to 200 gallons to each batch. From these the finished paint is deposited in the storage and filling tanks, whence it is filled into packages as required. Before the paint is filled into a package it is strained through a very fine wire sieve which removes every trace of "skin" or coarse particle.

Mixers.

Coloring and Shading.

Economy of the Manufacture.

Capacity

All the work is by gravity; the operations commence on the fourth floor and the paint is delivered into the packages on the first. The business is conducted so systematically that ten thousand gallons of paint may be delivered in ten hours without any pressure or confusion.

Some of the rules governing this department are well

worthy of notice. The uniformity of the shades and tints is preserved by a peculiar system of unchangeable standards. It is well known that white lead, zinc white and colors react on one another chemically, and slowly but surely change their original tone. Now, to prevent a change in the color-standards they are here made of absolutely non-changeable, inert material, which, while having no paint property of itself, serves to give the "shader" his unerring standard to which to shade each batch.

Uniformity of Manufacture.

Unchangeable Color-Standards.

After the shader has done his work and passed the paint, a practical painter samples the batch, paints it out, notes carefully its body, working and drying. It cannot be packed until he pronounces it correct in these particulars, when the packers may have it. From the packing tanks it is drawn off into a gauged receptacle holding ten gallons. This measure is on a truck; when the measure is full to the proper mark it is weighed by a weigh clerk, who compares the weight with the table of weights. If it vary more than one per cent. from the average weight, it is rejected and must be remanipulated. If found correct, it is filled into the desired packages.

Tests and Inspection.

It is well to note right here that much of the manufacture is packed in one-gallon cans. Much is said about "trade" gallons and "commercial" gallons. Now, the United States standard gallon is 231 cubic inches. Some manufacturers lay great stress on the alleged fact that their one-gallon cans hold 231 cubic inches; but even so, that does not permit 231 cubic inches of paint to be put in them; in other words, *a can cannot be entirely filled.* If the "Town and Country" one-gallon cans be measured, it will be found that their capacity is nearly 240 cubic inches, and that 231 cubic inches of paint are packed into them.

Honest Measure.

A practice, rapidly dying out, we believe is to sell

A View of the Working Floor, Ready Mixed Paint Department

what are called "trade" gallons. These hold less than seven pints. A can to *hold* one gallon should be not less than six and eleven-sixteenth inches in diameter, and six and three-quarter inches in height. Height is frequently used to deceive the unwary, as many so-called gallon cans are seven inches high, but only six in diameter, and such a can will not hold quite seven pints.

Dishonest Measure.

We have seen the manufacture of "Town and Country" ready-mixed paints from the crudest material to the finished product ready for use, and have learned much of the chemistry of the subject in plain, matter-of-fact language. A little more may be said in the way of practical chemistry, and then some practical suggestions will be given.

Perishing of Paint.

As the perishing of paint is almost entirely due to the destruction of the vehicle, and as nearly all the pigments which best fulfil the immediate or first requirements in paint-making are more or less chemically active and aid in the destruction of the vehicle, scientific paint making requires that the vehicle be rendered as inert as possible to the action of the pigment; and further, in ready-mixed paint-making it is very essential that chemical action should not take place between the components of the paint while it is in the package in the store-house waiting for the buyer.

Why "Town and Country" Paint Does Not Change.

In "Town and Country" paints this chemical action is prevented by keeping the paint in a state of emulsion. Unfortunately this plan of paint-making permits the unscrupulous manufacturer to palm off water for paint when the quantity introduced is more than sufficient for its proper use. Such a paint, however, will not be used by the practical painter or by any one who is a fair judge of paints. A good test of this paint is weight; taking the pale tints, which must contain the maximum of zinc and lead base. When properly made, the emulsified paint weighs 13 to

15 pounds per gallon; the water paints will weigh but 9 to 11. This rule will not apply to those dark colors which do not permit the use of any white in their preparation. These may be made of pigment and oil only, and weigh but 9 pounds.

In the "Town and Country" paints the oily vehicle is simply the purest linseed oil that is made, very carefully treated to make it durable, kept by emulsion in an inert condition until used, and rendered fluid for working under the brush by the addition of naphtha, which more than any other vehicle has the property of thinning a paint, and therefore may be used in smallest proportion; furthermore, every atom of this evaporates on drying, so that the pure pigment and durable oil only are left on the surface.

The reader who has followed these pages to this point is without doubt convinced that it would be difficult to find a paint superior to that produced in this establishment, and doubtless he believes that the proper place for mixing the paints—as it is for grinding them—is the factory.

Why there are Ready-Mixed Paints.

The change of the present day to paints ready-mixed, or entirely prepared for use, is in conformity with the general advancement of the age: it is not revolutionary or extraordinary; it is simply a step in natural evolution or progression. As the grinding of dry paints by hand with slab and muller was succeeded by the employment of steam machinery, so the mixing of paste paints by means of a stick into a condition for use has been superseded also, in its turn, by the use of mechanism specially designed. It is merely a repetition of the story we see everywhere around us: manual labor with its drudgery, want of uniformity, and want of completeness giving place to the perfection of scientific appliances.

Not only does the use of ready-mixed paints constitute a gain to the painter in convenience and economy,

saving drudgery, waste and time, but, what is of even greater importance (especially to the property-owner), there is also a material gain—when standard brands, such as the "Town and Country," are purchased—in the quality of the paints obtained. Under the old method of paint-mixing it is impossible to incorporate with the pigment more than a certain quantity of oil without interfering with its working qualities. Oil, however, is really the life of paint; it is mainly from the oil that paint obtains its preservative virtue, and it may be laid down as an axiom that the more oil (consistent with the retention of proper working qualities), and the better the oil the better the paint. This is one reason why the "Town and Country" paints are found so superior in durability to white lead mixed in the ordinary way, and it partially explains the gain in quality referred to above. The method of the preparation of these paints causes the incorporation of a much larger percentage of oil than has been possible by previous methods. When we add to this the fact that the process employed gives also a rich gloss or finish unobtainable in any other way, which, besides adding greatly to beauty of appearance, enables the paints to resist more effectually the action of the elements, the superiority of the new system over the old will be apparent.

Ready-Mixed Paints not Antagonistic to the Work of the Practical Painter.

The advantages of a paint ready for use (ready for use excepting the addition of more oil for raw surfaces) are now so well recognized that nothing need be said in their favor. Much condemnation of ready-mixed paints is heard because so many are inferior and give such unsatisfactory results. But no one condemns real money because there is counterfeit money, and no one condemns white lead or painters' colors because much that is sold is counterfeit. We know that good and pure may be had, and when once we are made acquainted with the

If no Real Thing, there would not be any Counterfeit.

reliability or lack of it in different brands, we are no longer imposed upon. So with paints ready for use. Some are good, many are bad. When we learn to discriminate between the good and bad, and use only the former, we shall recognize fully their value, their superiority for exterior work to any hand-mixed paint.

At one time skilled painters feared that giving up the control of mixing the paints they used might prove detrimental to their business; but so many have admitted the groundlessness of such fear by their regular use of high-grade mixed paints that this subject need no longer be considered.

Practical Painters use High-Grade Ready-Mixed Paint.

The manufacturers of "Town and Country" paint prefer that other paint be used by any one who will not employ a competent painter, because unskilled painters cannot do good work, and their lack of skill and experience leads to the condemnation of the paint used by them. Very few competent painters, and none who have intelligently tested it, will deny the superiority of the "Town and Country" for exterior painting when compared with best shop or hand-mixed material. They recognize its advantages, just as they recognize the advantage of buying white lead and colors already ground, instead of buying the dry pigment and vehicle separately and grinding them together in the shop; no one could do that now and earn his salt.

While it is an unquestioned fact that but few painters—and only those of great capacity and experience—can produce shades of color of such beauty and richness as are furnished, ready for use, in the "Town and Country" paints, and, while it is also true that painters, whatever their training, cannot produce paints of similar quality by the means at their command, still the object of the manufacturers is not to do away with, but rather to supplement the painter's work. There is no antagonism possible or intended. The manufacturers of "Town

and Country" paints, so far from endeavoring to lessen the use of experienced labor, most strongly urge and recommend its constant employment. They recognize that the greater the skill of the workman the better the results obtained from their material, and the better these results the more advantageous it is for the reputation of their paints, and, consequently, for their interests.

Suggestions in Using Paint.

To obtain satisfactory results it is not only essential to have the best material, but that material must be properly used. If work be done regardless of the conditions necessary to insure permanency, failure is simply invited and must be expected.

Hints on the Application of Paint.

Too much stress cannot be laid upon selecting the proper time for painting. Work done in wet weather or on rain-soaked wood or sappy or unseasoned wood is almost certain to fail. Work done hurriedly or with thick, heavy coats of paint is almost certain to result in disappointment.

See that your painting is done in dry weather. See that ample time is given between coats for each to dry; see that no more paint is used than is necessary; see that all new work has three coats. Three thin coats will take less paint than two heavy coats; and will wear better and longer. Above all things, see that you have an experienced, capable and honest man to do your work. Such a workman will probably give better results with poor material than the incompetent man will with the best material.

Guarantee.

Some manufacturers guarantee the durability of their paint, and, strange as it may seem, some of the poorest paints are most strongly guaranteed. The "Town and Country" paint is sold simply on a warranty of its purity and composition, and this warranty will be accompanied by any reasonable penalty required. The manufacturers know from a long

experience that properly applied, and used under proper conditions, nothing but the best results can be obtained, and they will not hold themselves responsible for the ignorance or cupidity of the property-owner or the inexperence or dishonesty of the one applying the paint.

It is absolutely necessary for good results that the original surface be put in good condition. It is a common error, even with experienced painters to believe that anything will do for priming; but as the priming coat bears the same relation to the succeeding coats that the foundation of a building bears to the superstructure, it is as fallacious to expect durability from a bad priming coat as permanence from a building that has a poor, uncertain or bad foundation. In many buildings the lumber is inferior, wet, or unseasoned. In such cases the priming coat should be applied when the weather is driest, and allowed to remain for some weeks before applying the other coats. The oil appears to displace the sap, hastening its evaporation. If the succeeding coats were applied at once, the sap would be held in, and finally result in peeling or scaling the paint. If the wood be well seasoned, no more time need be given after its application than sufficient to dry the priming coat thoroughly.

Primer, and Why Necessary.

Essential Properties of a Good Primer.

The essential properties of the priming coat are to fill the pores and make a surface to which the succeeding coats will firmly adhere. Therefore, the pigment should be one that will carry a large quantity of oil, and still make a workable paint, and also be chemically inactive, yet in such mechanical condition that its particles will attach themselves to the grain of the wood. White lead does not fill all these conditions so well as certain ochres that are free from clay, but which contain free silica in a sharp but finely-divided state. An ochre that will not carry three times its own weight of raw oil, and at the

same time be fairly thick paint, will not meet the requirements.

To meet the demand for a scientifically prepared primer, Harrison Bros. & Co., Incorporated, have manufactured the "Town and Country" "Primer and Filler." It is a mixture of their own strictly pure white lead and a specially selected ochre. Much less paint is needed over a proper priming with "Town and Country" "Primer and Filler.," and therefore both durability and economy are assured by its use. While this should be applied freely, it is to be thoroughly worked into the surface. If a heavy coat be applied to sap or yellow pine and allowed to stand for several months, it will be found that the sap or resin has been killed; this may then be cleaned off and the work finished, with most durable result. Work will not stand when finished at once, on green, sappy, resinous or waterlogged wood.

"Town and Country" "Primer and Filler."

As previously stated, not only is much of the ready-mixed paint that is offered for sale worthless, but so are many of the painters' colors and much of the white lead, and therefore one is liable to as much imposition, unintentionally or otherwise, on the part of the vender in buying the ingredients separately and mixing them himself as in buying them in mixed form. In fact, at this time (1898) there is more danger from sophisticated linseed oil and oil substitutes than even from white lead and colors.

Danger of Impure Oil.

Great Risk Mixing One's Own Paints.

An intelligent painter, writing from a Western city of 40,000 population, states that nearly all the painting done there in a year was with oil retailed at less than one-half the crusher's price for linseed oil, and asks, "Can any sensible man be surprised at the general dissatisfaction with painting?" Poor pigments and good oil are a better combination than the best pig-

The Consumer Insured Good Quality in Using "Town and Country" Paints.

ments and sophisticated oil. In using "Town and Country" paints the consumer is assured of the use of not only the best quality of oil and the best pigments, but the very best combination of them known in modern paint-making.

It is absolutely impossible to give a paint in mixed form—that is, of the proper consistency—for all kinds of surfaces and all sorts of temperature. When the surface is very raw or absorbent, a thinner paint must be used than for a hard or non-absorbent surface; and a paint that is of the right consistency for work in a temperature of 50° or 60° will be found quite too thin in a temperature of 80° or 90°. In "Town and Country" paint the consistency is just right for a hard surface and moderate temperature, and in general for a finishing coat. Oil or turpentine, or both, must be used for the undercoats, and these are the only articles to be provided in addition to the "Town and Country" paint. It therefore becomes necessary that every one using "Town and Country" paint assure himself that the oil or turpentine used is perfectly pure and of the best quality.

Paint Must be of Consistency to Suit Conditions of Surface and Temperature.

It is not contended that the use of cheap oils or linseed-oil substitutes is never justifiable, for there are occasions when painting is for temporary purposes only, and it may be wise to use material of only temporary value; but what is unjustifiable is vending impure oil or oil substitutes as pure linseed-oil; and it seems to us that the linseed-oil manufacturer and consumer have the same right to protection by law against such practice as the dairyman and the butter consumer have against the sale of oleomargarine as genuine butter. As the sale of oleomargarine as such is not objected to, so there cannot be any objection to the sale of substitute oils as such.

Our talk about priming has had reference to new work mainly. The repainting of a surface when the old

paint has thoroughly perished—that is, has become like dust—is quite a simple matter. After the surface has been thoroughly sand-papered and dusted the "Primer and Filler" may be used as for new work, or the color in which the work is to be finished applied at once; but not more than two coats, the first coat made very thin with raw linseed-oil and some turpentine. The "Town and Country" paint of usual consistency should be thinned for such work with about one quart of oil and one pint of turpentine to each gallon. The turpentine aids it to penetrate the pores of the old paint.

Repainting of Painted Surface.

When the old paint is very hard, but inclined to chip off, very great care is required to produce good results, because the new paint on top of the old will, by the contraction in drying, cause the latter to loosen its already feeble hold, and old and new come off together. The old paint will not permit the penetration of the new paint through it, so as to give it a new bond to the wood or original surface, and it is not sufficiently bonded to resist the contraction of the new coat in drying; thorough scraping must first be resorted to. Unless the color is to be changed, it is best to give such a surface but one coat, as thin as it is possible to work it and cover properly. If the color is to be changed, give two coats, but with an interval of several weeks, and each coat as light as it can be worked.

New Work

New work should always have three coats, the first to be of "Primer and Filler," or white lead, as previously directed. The second and third coats are to be of the color selected. The "Town and Country" paint for second coat is to be thinned with about one quart of oil and one pint to one quart of turpentine to each gallon. This coat must be well brushed out. For the finishing coat the "Town and Country" paint is usually of proper consistency; if too stout, add raw linseed oil

in just sufficient quantity to make the paint work freely under the brush.

On every package of paint a few plain and explicit directions are given.

Quantity Required. It is obvious that the quantity of paint required will vary according to the state of the surface to be painted. For new work on lumber fairly smooth and of good quality it will be safe to estimate 275 to 300 square feet of surface per gallon, three coats, used as above directed, about two-fifths to be "Primer and Filler," or white lead. On a surface properly prepared with "Primer and Filler," one gallon of "Town and Country" paint will cover 300 square feet or more of surface, two coats. The great economy of the paint is at once apparent.

Economic House Painting. Economic house-painting, it is thus seen, does not depend upon buying the lowest-priced materials; such generally have but little pigment or vehicle value, and are, therefore, relatively dearer; and they lack the element of durability. That paint is best which can be laid on in the thinnest layers. The cheap nostrums must be "flowed on" in thick layers, otherwise the surface will not be covered.

The Harrison establishment is the only one in which are conducted all the processes of manufacture, from the crude material to the finished product.

Measuring. When measuring for quantity required do not make any allowance for window and other openings, as they will about equal the extra surface of frames, mouldings and other projections. It is quite proper to take the length, breadth and height of a building in full.

Selection of Colors. Positive rules for the selection of colors cannot be given. It is probably one of the most difficult features in the work of beautifying the home; so difficult is it that the property-owner will

frequently waive his or her natural good taste and defer to the judgment of the painter. This is well when the painter is progressive, has fine taste and will continually work on new color schemes, instead of (as is too frequently the case) following one idea, and that usually very dull or inharmonious. The great variety of colors in the "Town and Country" paints permits every possible scheme to be followed. One well-painted house in a community that has had a long affliction of stone color or drab creates an improvement in the general taste, leading quickly to the betterment of the entire neighborhood, and increasing the value of property. It is now quite common to find suburbs of cities of most picturesque appearance due entirely to the use of "Town and Country" paint in bright and harmonious combination of the different shades. As it is impossible to give satisfactorily in words a guide for the selection and application of colors, some illustrations are furnished as suggestions of good color effect; but printers' ink fails to do justice to the subject. The parent house of Harrison Bros. & Co., Incorporated, or either of its branches, at New York and Chicago, will suggest combinations on receipt of architect's elevation, photograph or sketch of building, and will give full directions for placing each color. Due regard must be given to the architecture of the building in both the selection and the application of the colors; though in general, any combination which is good of itself may be used, provided each element is properly proportioned.

Artistic Painting Improves Property Values.

Illustrations.

Architecture of Building Must be Considered.

Harmonious color selections may be made from either analogous colors or complementary colors. It has become common to use the latter system, yet it is one which requires the best development of the color sense, and for this reason better results are generally obtained by one with natural good taste than by one without who

attempts to apply the theory of complementary colors. Where there is a combination of the two systems very pleasing results are obtained; for instance, a gradation from an olive brown to a light but warm yellow tint. This subject, however, can be covered satisfactorily by illustrations only.

"Town and Country" Paint. where Used.

"Town and Country" paints are intended primarily for exterior house-painting, but, properly used, they make an equally good interior paint. For plastered walls they are exceptionally valuable, making a finish that will permit continued cleaning. For the plastered walls of kitchens and bath-rooms they make a finish inferior in value only to glazed tile.

Floor-Painting.

For floors they will not dry flinty enough unless applied in numerous thin coats; for such use they should be thinned well with refined naphtha (benzine). For floor-painting it is best to use Harrisons' "Floor and Deck" paints, which are especially prepared for such purpose; these are actually hardened by washing and are very resistant to ordinary wear.

Furniture-Painting

For furniture-painting a different system is necessary. Paints as prepared for house-painting will not do for furniture. Harrisons' Varnish Carriage Paints or Interior Decorative Enamels may be used for furniture-painting or decoration with most satisfactory results.

Vessel-Painting

"Town and Country" paints have been found eminently durable and economical for vessel-painting and are recommended for such use.

Testimonials.

Testimonials could be furnished *ad nauseam*. Better evidence of the value of these paints than their long-continued use by the most intelligent painters cannot be offered. There are many who cannot appreciate the difference between good and

bad, but the Harrison establishment does not exist for such.

We have refrained, thus far, from mentioning the subject of varnishes, which, although last, is by no means least among the many departments of our works. In one way we may be said to be introducing ourselves to the trade as varnish makers, and as such we wish to be accorded a favorable reception, on the strength of our reputation of over a century as manufacturers of white lead, colors and chemicals of the highest quality. At the same time we are by no means new to the manufacture of varnish, as we have for many years made, for our own consumption, more than the annual product of some of the best known houses manufacturing varnish only, and inasmuch as this article is so naturally and intimately allied to our other lines, we recently decided that we belonged in this business. To this end we have brought our varnish plant right up to date by the erection of new buildings, equipped with the most modern apparatus for the production of the finest goods by the latest and most approved processes, and it is our intention to supply from our own factory everything that goes by the name of varnish, of a quality fully equal to that which is now on the market, mark for mark, and at prices which cannot fail to interest buyers. Our standard goods will represent in varnish what our standard colors represent—absolute purity; and our goods, made to specification, will offer more value for the money than is elsewhere obtainable. In conclusion we will state that all our varnishes are made of the best material, combined with the highest degree of varnish-making skill that can be commanded. They are not the result of scientific tests alone, but of practical tests as well. Guesswork has played no part in their development and all experiments have been made "at our own expense."

The various remarks which have been made throughout this little work bearing on the grade of material, ex-

cellence of workmanship, etc., apply equally well to varnish as to paints, and it is scarcely necessary for us to add more in the same line. What we believe in one department of our business to be the only right and proper policy, we believe for all other departments, and our aim has been, and always will be, to have all material sent out from our factory of the highest possible grade of workmanship and quality, and at all times suited for the work for which it is designed.

Conclusion.

We have already made the description of this extensive plant longer than originally intended, and in conclusion are pleased to state that any one interested in paints and painting is cordially invited to visit it and see for himself what these pages are intended to describe.

ALL PAINTS

Bearing the Name of

Harrison Bros. & Co., Incorporated.

and claiming by the Label to be

PURE

are Guaranteed to be of

ABSOLUTE PURITY